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THE LEAF

by

GWEN CROSS

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CONTENTS

		Page
Chapter I.	LEAVES	4
Chapter II.	KINDS OF LEAVES	7
Chapter III.	LEAF FALL	10
Chapter IV.	SEEDS BREATHE	15
Chapter V.	THE WORK OF LEAVES (1)	17
Chapter VI.	WHAT PLANTS ARE LIKE INSIDE	19
Chapter VII.	HOW WATER MAKES PLANTS STAND STRAIGHT AND FIRM	21
Chapter VIII.	THE WORK OF LEAVES (2)	23
Chapter IX.	HOW TRANSPIRATION HELPS THE PLANT	26
Chapter X.	ABOUT TRANSPLANTING	27
Chapter XI.	THE WORK OF LEAVES (3)	29
Chapter XII.	HOW TO SHOW THAT LEAVES MAKE STARCH	31

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NOTE ON THE USE OF THE BOOK

Chapters are divided into:

1. The Lesson.
2. Things to do and/or
3. Questions.

The main point of this book is the practical work in the garden and class room. Emphasis should be laid on:

1. Careful observation.
2. Clear, big, tidy records and drawings in the class room and books.

The drawings are diagrams. They should be drawn on the blackboard, piece by piece, slowly, while the class copies, piece by piece. The names should be written clearly, straight, and one under the other. Full directions should be given as to the size and spacing of diagrams, etc.

The book may be taken as it stands by any class whose English is sufficient.

The course can also be taken with a junior class which does not know much English yet, but can read and write in some language, and is beginning to "awake," i.e. at the end of the first year or in the second year at school. At this stage the English reading of the lessons and the answering of the questions in English are omitted. The lessons and questions can be used as a Reader and for revision later if desired.

CHAPTER I

LEAVES

LESSON

In many leaves we can clearly see three parts—the base, the stalk, and the blade (Fig. 1).

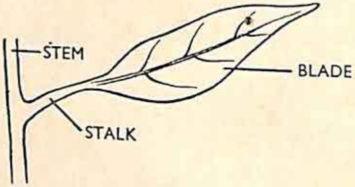


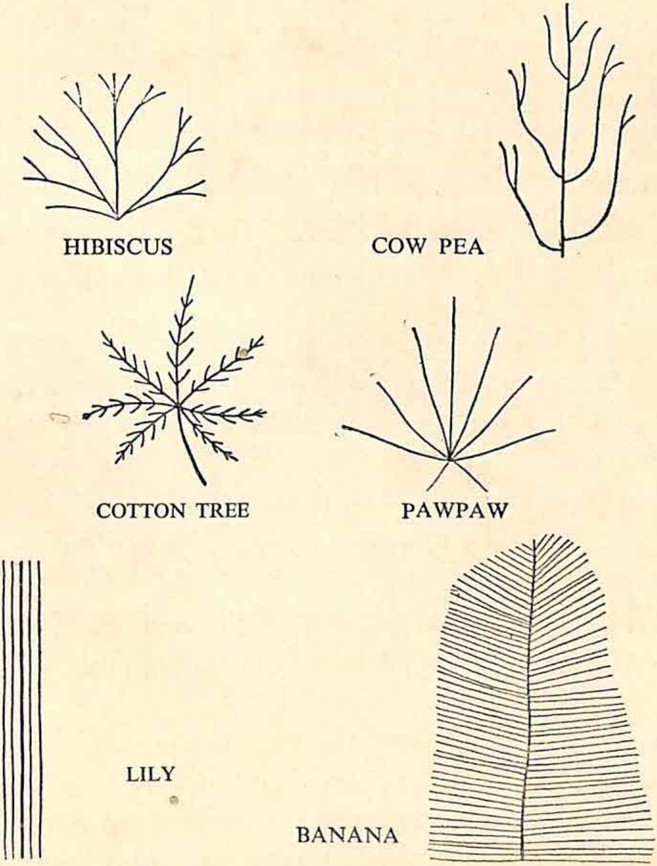
FIG. 1. THE PARTS OF A LEAF

The base is the bottom of the leaf stalk. It is sometimes fat, sometimes hollow, sometimes wide and flat.

The leaf stalk joins the leaf to the stem. In the pawpaw this is very long and hollow. In other plants it is so short that we cannot see it easily. The blade is the biggest and most important part of the leaf.

On the blades of all leaves we see many veins

(Fig. 2). Some of the veins are wide, others are narrow. The veins divide and go out to each part of a leaf. Each time a vein divides, the branches of



HIBISCUS

COW PEA

COTTON TREE

PAWPAW

LILY

BANANA

FIG. 2

it are narrower. The little veins of a leaf are finer than a piece of cotton.

When a leaf rots, the part between the veins rots first. Then the little veins rot; then the big ones. The veins take water and food to all parts of the leaf.

In some leaves, like those of lilies, the veins are all long and in parallel lines. In others they divide like the fingers of a hand. In others they are like a net.

THINGS TO DO

1. Go round the garden and collect leaves. Take them carefully from the plants. Find some with big and some with small bases. Find some with long, short, hollow, solid, fat, or thin stalks.
2. Look at the blades. Find a leaf with parallel veins (lily). Find one with net veins (hibiscus). Find one with veins like the fingers of a hand (pawpaw).

QUESTIONS

1. Name the three parts of a leaf.
2. What part of a leaf blade rots first?
3. What work do the veins do?

CHAPTER II

KINDS OF LEAVES

LESSON

The blades of some leaves are divided into several quite separate pieces. The blades of other leaves are in one piece.

The first kind of leaves are called compound leaves (Fig. 3). Each piece of the blade is called a leaflet. Cow peas have three leaflets for each leaf. Peanuts have four leaflets. Coconut leaves and sago palm leaves have very many leaflets. One

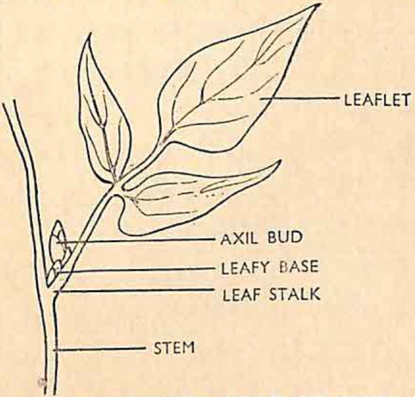


FIG. 3. COMPOUND LEAF OF COW PEA

palm has 100 leaflets for each leaf. All the plants of the cow pea family have compound leaves.

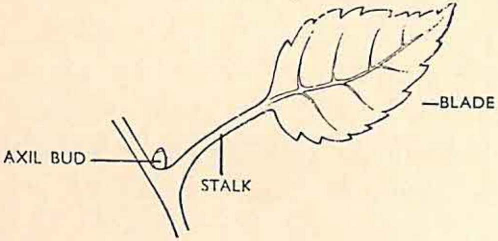


FIG. 4. SIMPLE LEAF OF HIBISCUS, ONE BLADE NOT DIVIDED

The second kind of leaves are called simple leaves. Hibiscus. mango, yam, sweet potato, taro, cucumber, maize—all have simple leaves (Fig. 4).

The blades of some leaves are not divided into separate leaflets, but are made up of parts of different shapes on one leaf stalk. Water melon and pawpaw leaves are like this (Fig. 5).

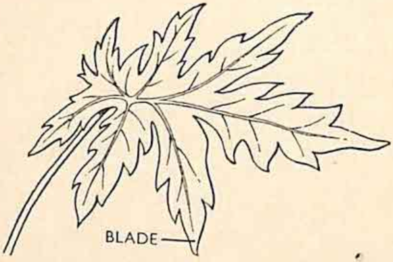


FIG. 5. SIMPLE LEAF OF PAWPAW, BLADE MUCH DIVIDED BUT NOT INTO SEPARATE PIECES

At the bottom of a leaf, between the base and the stem there is always a bud. The bud is sometimes very small and we cannot see it easily. But it is there. Inside the bud there is a small stem and small young leaves. By and by the bud opens and grows into a branch. The place between the leaf base and stem is called the leaf axil. The bud is called the axil bud. Branches always grow from the axils of leaves.

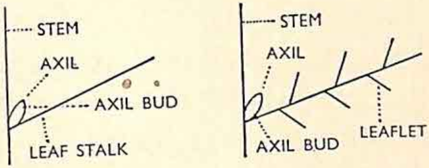


FIG. 6. TO SHOW WHERE THE AXIL BUD IS

There is no axil bud where leaflets join on to the leaf stalk. When we want to know if a leaf is the blade of a simple leaf or a leaflet of a compound leaf we look for the axil bud. If there is no bud in the axil the blade is a leaflet. If there is a bud the blade is a simple leaf (Fig. 6).

THINGS TO DO AND QUESTIONS

1. Collect leaves (on the stems) of plants with single leaf blades. Look for the axil bud.

2. Draw the hibiscus leaf. Name base, leaf stalk, blade, stem, axil bud, veins.

3. Look at leaves of pawpaw and water melon. See that there is only one leaf stalk and one bud at the leaf axil.
4. Collect from the bush if you can two simple leaves, two compound leaves, two simple leaves with divided blades.
5. Where is the leaf axil ?
6. Copy a sentence that tells you how to know a compound leaf.
7. Copy a sentence that tells you how to know a simple leaf.

CHAPTER III

LEAF FALL

LESSON

The leaves of plants die and fall to the ground. New leaves grow from new buds on branches and stems. In countries where there is a cold winter for some months of the year, as in England, Australia and the United States, all the leaves fall off many of the trees in the autumn, or 'fall', that comes after the summer. In the winter the branches of these broad-leaved trees are bare (Fig. 7). The buds rest. When winter is finished the buds open in the spring. The leaves are on the trees in the summer (Fig. 8), and fall in the autumn.

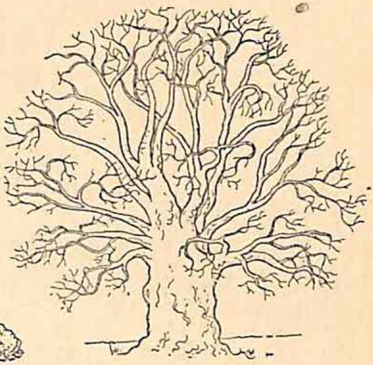


FIG. 7.
OAK TREE IN
WINTER

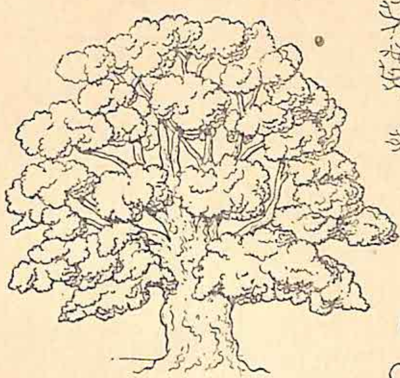
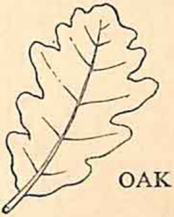


FIG. 8. OAK TREE IN
SUMMER



OAK LEAF

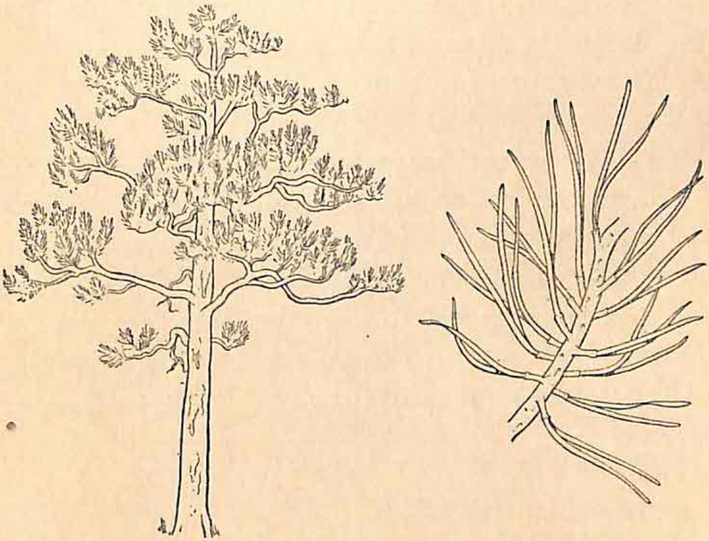


FIG. 9. PINE TREE AND PINE TWIG WITH NEEDLES

If the leaves stayed on these trees through the winter, the tree would be exposing such a great amount of surface to the cold winds that the trees would "die of cold." Trees that keep their leaves through the cold winters have always narrow leaves, like needles. Pine trees have needles like this (Fig. 9). These narrow-leaved trees expose much less surface to the cold winds.

In hot tropical countries where there is no winter, all the leaves do not fall off trees at the same time. Coconut leaves fall all round the year. Banyan and frangipanni leaves fall sometimes. We never see all the trees bare. When leaves fall from the trees it is not long before buds open and there are leaves on the trees again. There are no cold months when trees might die of cold.

When leaves fall from a plant they break at the place where the leaf base joins the stem. Then we see on the stem the scar where the leaf grew. This is called the leaf scar. We can see clearly the leaf scars on stems of pawpaws, cassava or manioc, and coconuts and other palm trees. Leaf scars are of different shapes. Sometimes they are round. Sometimes they are the shape of a new moon. After the leaf has fallen, the bud is above the leaf scar.

THINGS TO DO

1. Collect branches of different plants. Take off the leaves. What shape are the leaf scars? Find the buds.

2. Look at cassava stems. When you plant them how do the buds and leaf scars help you to know which way to put the branch in the soil? Draw a diagram of a piece of cassava stem showing the way you would plant it. Name leaf scar, bud and stem (Fig. 10).

3. Look at the leaf scars and buds on a pawpaw stem. Where do the flowers grow? (Fig. 11).

4. Write down the names of the months of the year. Watch the trees. When the leaves of a tree fall write the name of the tree under that month.

5. Look for a plant with big buds. Take off one bud (Fig. 13). Take away each leaf carefully, one by one. Put the leaves that are like one another in groups. Try to find:

    1. Outside brown leaves.
    2. Inside green leaves.
    3. Smaller green leaves.
    4. Still smaller green leaves.
    5. A small stem.
    6. Perhaps you can see very small flower buds on the stem. Put a shoot with buds on it into water and watch the buds open.

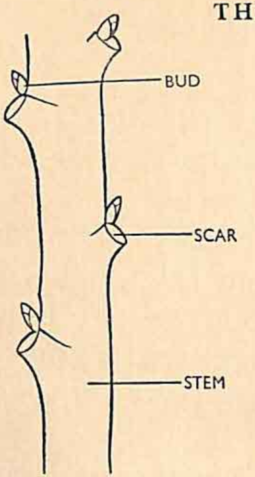


FIG. 10. MANIOC STEM

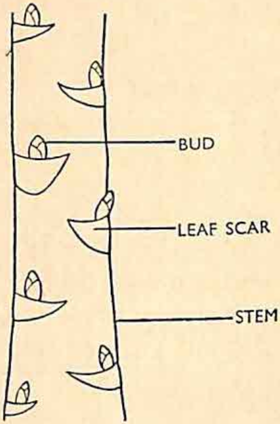


FIG. 11. PAWPAW STEM

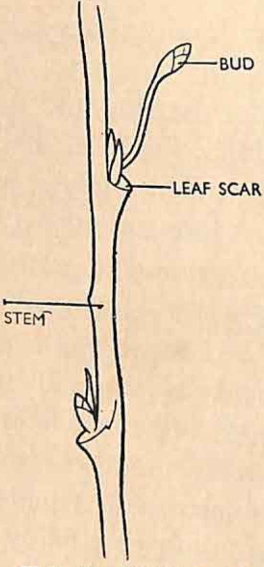


FIG. 12. HIBISCUS STEM

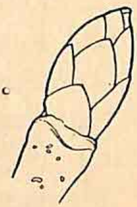


FIG. 13. BUD

LEAF SCARS AND BUDS ON STEM

QUESTIONS

1. Name two countries where the leaves of many trees fall in winter.
2. What is the leaf scar?
3. Which is higher on the stem: leaf scar or the axil bud?
4. Name four seasons of the year in England and other cool countries.
5. Why do the leaves of many trees fall in countries where there is a cold winter?
6. Write the name of a tree whose leaves fall some at one time and some at another time.

CHAPTER IV

SEEDS BREATHE

LESSON

Seeds grow and make strong seedlings when they have enough air, water, food, light and heat.

All living things want air. We cannot live three minutes without air. When we take air through our noses into our lungs we say that we breathe. When we breathe in, a part of the air we breathe stays behind in our bodies. When we breathe out again, what we breathe out is different from what we breathed in.

If we blow down a narrow, open piece of bamboo into clear lime water we see bubbles of what we blow out of our lungs. The bubbles make the lime water milky (Fig. 14).

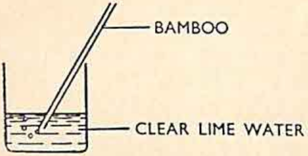


FIG. 14

If we put some seeds of the cow pea in water for a few hours we shall see little bubbles of air come from them, and the seeds will swell.

Put some of these seeds in a wet calico bag. Get a bottle. Put a little water at the bottom of the bottle. Get a small bottle. Put in it some clear lime water. Hang it with a thread in the big bottle. Hang the bag of seeds in the big bottle. Let a narrow piece of rag hang from the bag to the water. Then the bag of seeds will keep damp. If they are too wet they will make a bad smell. Put a tight cork in the bottle (Fig. 15).

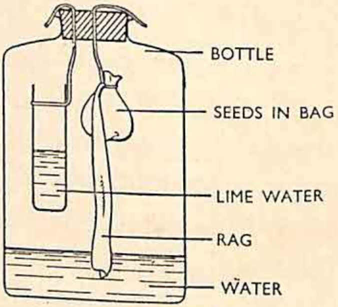


FIG 15

Watch the seeds and the lime water. By and by you will see little roots growing through the bag. The lime water will become milky.

Take out the cork and quickly put a lighted match into the big bottle. The flame dies. The air in the bottle is now different. The part of the air that helps a match to burn has gone. This part is oxygen.

The growing seeds breathed in the oxygen in the bottle. The growing seeds breathed out into the bottle something which makes the lime water milky.

QUESTIONS

1. What did the seeds take from the air?
2. Did the seeds put anything into the bottle?

CHAPTER V

THE WORK OF LEAVES (1)

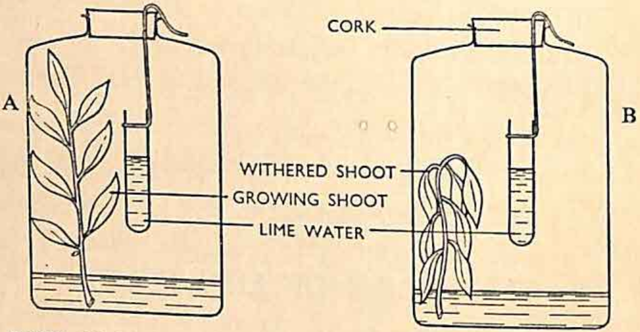
How Leaves Breathe

LESSON

All parts of a plant breathe. They breathe through very small holes called pores. There are very many small pores in the skin of leaves. We can only see these through a microscope.

Put two shoots with leaves, or two small plants with roots, in two bottles of water. Put enough water at the bottom of the bottles for the plants to drink. Label the bottles A and B. In both bottles hang a small bottle of clear lime water. Put a tight cork in both bottles.

By and by we shall see that the lime water in both bottles is milky. Both shoots have breathed out something which makes the clear lime water milky. Now take out the cork from bottle A (Fig. 16). If we leave the shoots a few days, we shall see that the shoot in bottle B dies (Fig. 17). If we take out the cork and quickly put in a lighted match, the light goes out. The shoot has breathed in all the oxygen in the air in the bottle. When the oxygen is finished, the plant cannot breathe and it dies.



FIGS. 16 AND 17. TO SHOW THAT LEAVES BREATHE

The shoot in bottle A, which has now no cork, does not die. If we put a lighted match in the bottle, the match still burns. New air can go into the bottle all the time. The shoot can breathe all the time, so it does not die.

Plants, like men, will die if there is no air. Men and animals breathe with lungs. Fish breathe with gills: they take air from the water. Plants breathe with pores.

QUESTIONS

1. Why does the lime water become milky in both bottles?
2. Why does the match die in bottle B?
3. Why does the shoot die in bottle B?
4. Why does the match still burn in bottle A?
5. Why does the shoot not die in bottle A?
6. When plants breathe what do they take from the air?
7. What do you breathe with?
8. What does a fish breathe with?
9. What does a yam breathe with?
10. What does a cat breathe with?

CHAPTER VI

WHAT PLANTS ARE LIKE INSIDE

LESSON

If we could look at a thin piece of a leaf, stem or root under a microscope we should see that it is made of many little "rooms" or "boxes." These boxes are called cells. Some are round. Some are long. Some are narrow. Some have four sides or walls and some have still more sides. Some have thick walls and some have thin walls. All living things are made like this. Here is a picture to show you what the cells look like (Fig. 18).

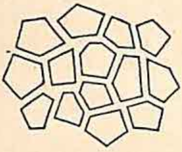


FIG. 18

These cells look empty, but they are not empty. In each cell there are air, water, food in the water, and a living thing.

Towards the middle of root stems and leaves, cells are long and narrow. They look like pipes. They carry water and food up the plant from the roots through the stems to the leaves (Fig. 19). In the leaves many of these pipes are grouped together to make the veins.

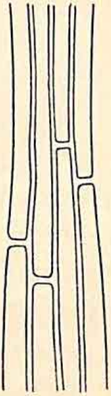


FIG. 19

QUESTIONS

1. If you cut a stem and put a thin piece under a microscope, what do you see the plant is made of?
2. What are in some of these "cells"?
3. What shape are the "cells" that take water up the plant?
4. What do these pipes together make in the leaves?

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CHAPTER VII

HOW WATER MAKES PLANTS STAND STRAIGHT AND FIRM

LESSON

If we go into the garden at midday we shall often see leaves of little plants hanging down, and their stems bent. The plants are weak and soft. We say that they wilt. If rain comes, we soon see the leaves stand out straight and the stem is strong again.

The rain water went from the soil through the root hairs. This water has made the plant strong. When there was not enough water, the plant was weak. Water cannot stand up straight! Water is not firm! How can it make leaves and stems straight and firm?

If we take a pig's bladder and blow air into it, the bladder becomes big and firm. We can play ball with it. If we let out some or all of the air the bladder becomes small and soft again. We can do this many times. If we filled the bladder with water it would also become big and firm. If we

BANIPUR

poured out some or all of the water, the bladder would become small and soft again.

The cells in the plants are like bladders. When they are full of water they are big and firm. Then the plants stand straight and firm. When they have not enough water the cells are smaller and soft. The plants are then weak and soft. They wilt. Stems bend. Leaves hang down. This is because the cells are living things. The plant itself can push the water from one cell into the next.

QUESTIONS

1. Why do leaves hang down on little plants when the sun is very hot? Write down the name of any plant you see like this (pumpkins show this well).
2. If you give the wilted plant water, what will you see by and by?

CHAPTER VIII

THE WORK OF LEAVES (2)

How Water Goes Through and Out of the Plant Again

LESSON

When the root hairs take in water the cells become big and firm. Water goes from cell to cell, until it reaches the long narrow pipes. There are no holes between the cells. Water goes from cell to cell through the walls of the cells.

Water goes up the roots, up the stems, to the branches and leaves. Something in the long narrow pipes of cells in the leaf vein pushes the water from the pipes out into the other cells in the leaf. The water goes outwards from cell to cell in the leaf in the same way as it went inwards from cell to cell in the root. Then the water goes out into the air through the little pores on the under side of the leaf (Fig. 20).

These little pores are little mouths that open and shut. The mouth opens into a little room full of air

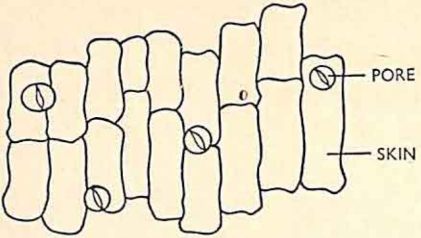

FIG. 20. THE SKIN OF THE LEAF UNDER THE MICROSCOPE SHOWING THE MOUTH-LIKE PORES

between the cells. Water from the cells goes into this room and out through the pore (Fig. 21). If a bucket of water is put in the sunshine, the water

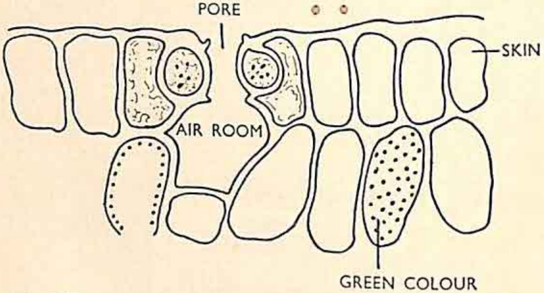

FIG. 21. THE LEAF CUT THROUGH TO SHOW A PORE AND THE ROOM OF AIR UNDER IT. MADE VERY MUCH BIGGER BY MEANS OF MICROSCOPE

in it will get less. The water goes into the air. We cannot see it go into the air. In the same way we cannot see water from the plants go into the air.

There are little pores in the skins of our own bodies. Through these pores, water goes from our bodies into the air. We do not see this water unless we are hot and there is more water than can go quickly into the air. We say we *perspire*. When plants give water back to the air through their leaves we say they *transpire*.

THINGS TO DO

Put a shoot, or small plant with roots, through a hole in the cork of a bottle. Put water in the bottle. Put the cork and plant in the bottle so that the plant can drink the water. Do this in a small bottle.

Now put all this in a big bottle. Cork the big bottle. The plant drinks water from the little bottle. The water goes out again through the leaves. Now there is more water in the air in the big bottle than there was before.

In time we shall see little drops of water form on the inside of the big bottle. This water cannot have come out of the small bottle because that has a cork. It can only come from the plant.

QUESTIONS

1. How does the water go from cell to cell?
2. What does the water go through into the air?
3. What does this little pore open into?
4. Can you see water go into the air?
5. What does your skin do when you perspire?
6. What does a leaf do when it transpires?

CHAPTER IX

HOW TRANSPIRATION HELPS THE PLANT

LESSON

When we perspire, water goes from our bodies into the air, and takes away with it some of the heat of our bodies. We perspire very much when we are hot. This perspiration helps to make our bodies cool.

When plants transpire, water goes from leaves into the air, and also takes away with it some of the heat from the plant. Transpiration helps to make plants cool.

Water is always moving upwards through the plant from the roots to the leaves. Plant food in the soil dissolves in this water. When the water moves up, the food goes with it. As the water goes to all parts of the plant, food goes also to all parts of the plant. In this way transpiration helps food to go up from the roots to stems, leaves and flowers.

QUESTIONS

1. How does it help our bodies when we perspire?
2. How does it help the plant when it transpires?

CHAPTER X

ABOUT TRANSPLANTING

LESSON

Water is always moving from roots to leaves. If the roots take in more water than the leaves give out, the cells are full of water. The plant is straight and firm. If the leaves give out more water than the roots take in, there is not enough water in the cells. The plant is weak and soft.

In the sunshine and wind, leaves give out much more water than when in shade and still air That is why plants wilt quickly in hot sunshine, but stand straight and firm on a cloudy day and at night.

When we plant tomato shoots or the shoots of any plant, or when we transplant seedlings, it is good to do this on a cloudy day or in the afternoon. Then the leaves do not lose a lot of water all through a hot sunny day. Their roots are not strong enough to take in water. The leaves give out more than the plant can take in, and the plants wilt in the hot sun. If the plants do not soon get enough water, they die.

When we transplant shoots and seedlings, it is good to cut off some of the leaves if there are very many. If there are not many leaves, the plant cannot lose much water. Then it will not wilt so much.

If you want to give water to plants do so when the sun is not shining on them.

QUESTIONS

1. What happens if the leaves of a plant transpire more than its roots drink?
2. What two things make plants transpire much?
3. When will plants wilt most: at midday or at midnight? Copy a sentence which tells you why.
4. When would you plant shoots?
5. Why is it better to plant seedlings on a cloudy than on a sunny day? Copy a sentence which tells you why.
6. What can you do when you transplant seedlings to help them so that they will not wilt?
7. When should you give water to plants?

CHAPTER XI

THE WORK OF LEAVES (3)

Leaves Make Food from the Air

LESSON

Leaves breathe, leaves give out water, and leaves also make food. They are the factories of the plant. A factory is a place where things are made. Nails, calico and soap are made in factories. Plant factories make starch.

Only green leaves can make starch. White and yellow leaves cannot make it. Green leaves can make starch only in the sunlight.

Starch will not dissolve in water. Only foods that dissolve in water can be used by the plant. So after the leaves have made starch, they change the starch to sugar. Sugar dissolves in water. Sugar can go to all parts of the plant.

Plants often store food. When they do this they change the sugar back again into starch. Sugar goes from the leaves to the growing seeds in the seed box. In some plants the seed changes the sugar again to starch and stores the starch in the seed leaves. Beans and peas have starch in their two big seed leaves. Maize and rice have starch in the seed but not in the seed leaves.

Other plants store starch in roots and stems. Starch made in the leaves of yams and potatoes goes to the root. The yam or potato becomes bigger and bigger as it stores more starch. This starch is the food for the new plant next year. It is also good food for us.

QUESTIONS

1. Copy the sentence which tells you the three jobs of work that leaves do.
2. From what two sources do plants take food?
3. What part of the plant takes food from the soil? What part takes food from the air?
4. What kind of leaf takes food from the air?
5. When do green leaves take food from the air?
6. What sort of food do leaves make?
7. Into what is starch changed, so that the food can go from the leaves to all parts of the plant?
8. When plants store food, into what do they change the sugar?
9. Where is food stored by: cow peas, maize, yam, potato, shallot, nuts, coconut, tomato.

CHAPTER XII

HOW TO SHOW THAT LEAVES MAKE STARCH

LESSON

Take two green leafy shoots. Put each in a bottle of water in the house for the night. Label them A and B. Next morning put bottle A in the sunlight. Put bottle B in the shade. See that bottle A always has the sun shining on it, and that bottle B never has the sun shining on it.

At the end of the day take a leaf from each shoot. Dip both in boiling water for a few minutes. This kills the leaves. Then put the leaves in methylated spirits. The green colour in the dead leaves now comes out into the methylated spirits. Now put the leaves in iodine.

Starch becomes blue with iodine. The leaf from bottle A that was in the sunlight becomes blue. There is starch in it. The leaf from bottle B that was in the shade does not become blue. There is no starch in it.

Green leaves make starch only in sunlight. If you do this experiment with a leaf that is part green and part yellow or white, you will see the blue colour only in the parts that were green.

(*Note.* When the leaves are in the dark, the starch in them is taken away as sugar. Next morning the experiment begins with no starch in the leaves in either bottle.)

THINGS TO DO

1. Cut a potato in half. If you put iodine on it, what happens? In what part of the potato is the blue colour strongest? (Fig. 22.)

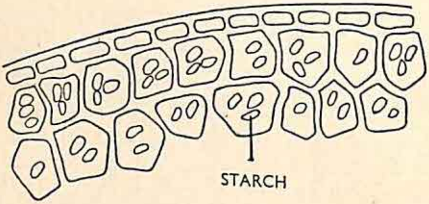

FIG. 22. THE POTATO UNDER THE MICROSCOPE SHOWING THE STARCH STORED THERE

2. If you put iodine under the cover of glass with a thin piece of potato and look at it under the microscope you will see each grain of starch is blue. There will be very many blue grains near the skin.

3. Test rice, beans, etc., for starch.

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